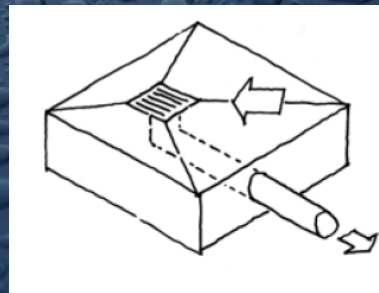


# Integrating Hydromodification Management Into the SUSMP

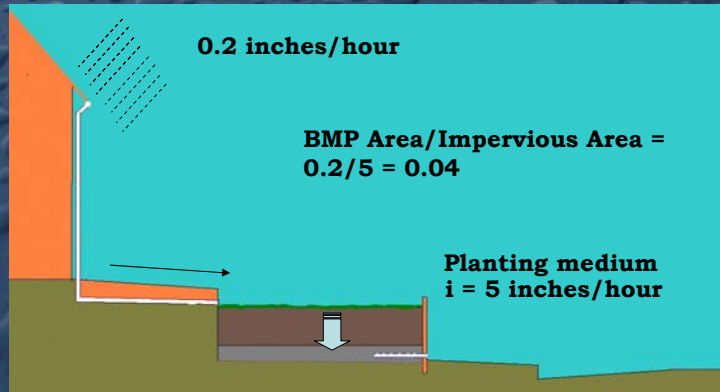
Dan Cloak, P.E.  
Dan Cloak Environmental Consulting

## Showing Treatment Compliance

- NPDES Permit sizing criteria for treatment control:
  - “collect and convey” drainage design
  - conventional, “end of pipe” treatment
  - use of “C” factors to determine design inflow or volume



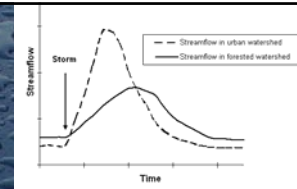
# Sizing criterion for treatment



# Application of sizing factor



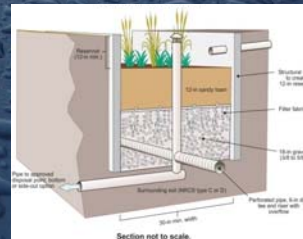
## LID for flow control



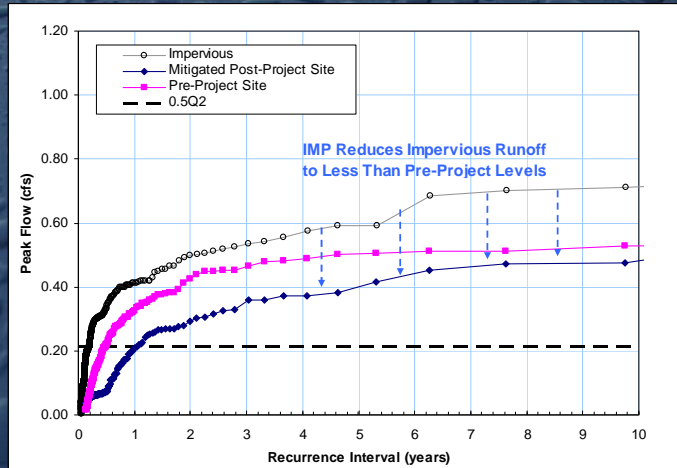
- Can LID facilities mitigate increased peaks and volumes of flows from impervious areas?
- How would we demonstrate that?
- What are the design criteria?

## HSPF analysis of unit-acre runoff

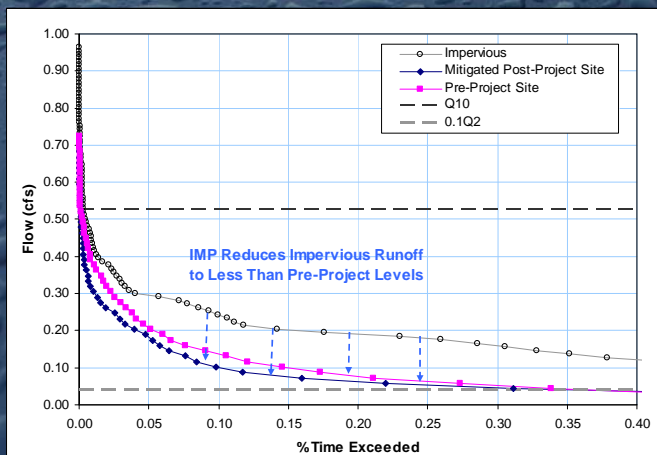
- 33 years hourly rainfall
- Pre-project condition
- 100% impervious condition
- Hydrologic soil groups A, B, C, D
- Swales, Bioretention Areas, In-ground and Flow-through Planters
  - Underdrain with flow-restrictor in C&D soils
- Dry wells, infiltration trenches and basins



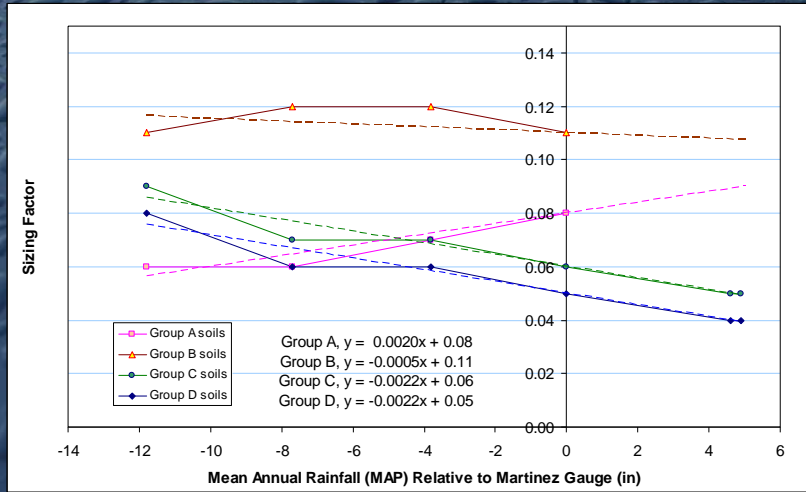
## Results: Control of Peak Flows



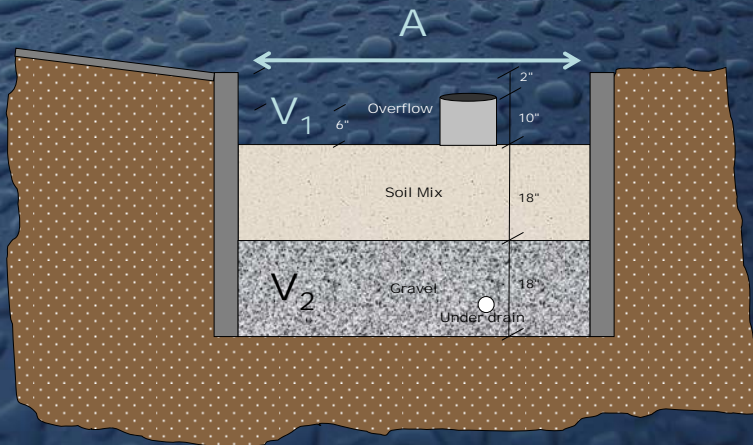
## Results: Flow Duration Control



# Adjustment to annual rainfall

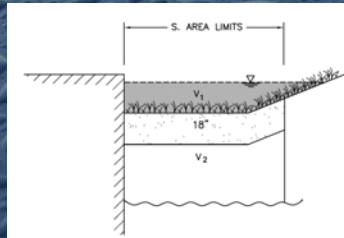


# Bioretention for Flow Control

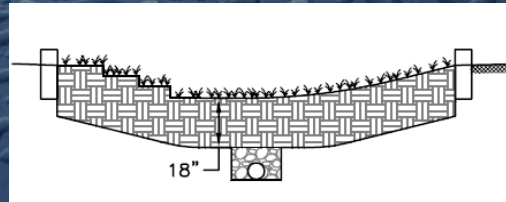


# Bioretention Design Options

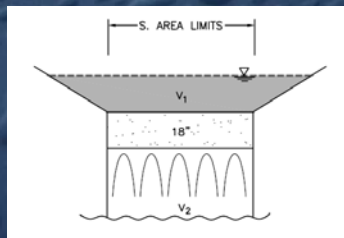
Edge Treatments



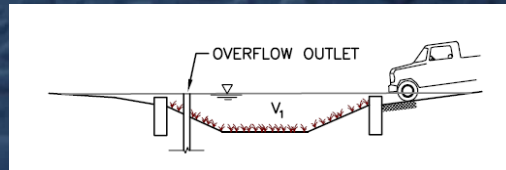
Stepped-back side slope



Subsurface Storage Options



Using Shallow Flooding for Storage

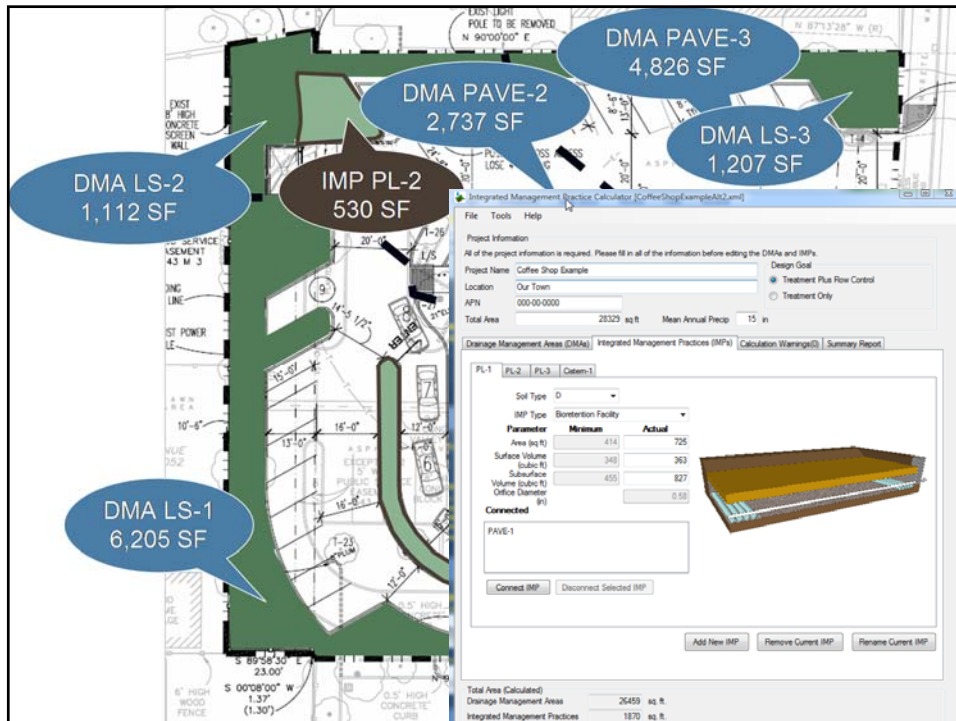


# Sizing Factors for Flow Control

Treatment & Flow Control	NRCS Soil Group			
	A	B	C	D
<b>Bioretention Facility</b>				
A	0.07	0.11	0.06	0.05
V <sub>1</sub>	0.058	0.092	0.050	0.042
V <sub>2</sub>	N/A	N/A	0.066	0.055
<b>Flow-through Planter</b>				
A	N/A	N/A	0.06	0.05
V <sub>1</sub>	N/A	N/A	0.050	0.042
V <sub>2</sub>	N/A	N/A	0.066	0.055
<b>Dry Well</b>				
A	0.05	0.06	N/A	N/A
V	0.130	0.204	N/A	N/A
<b>Cistern + bioretention facility</b>				
A (bioretention facility)	0.04	0.04	0.04	0.04
V (cistern)	0.193	0.228	0.088	0.060

# Calculation Format with Flow Control

DMA Name	DMA Area (square feet)	Post-project surface type	DMA Runoff factor	DMA Area × runoff factor	IMP Name			
					IMP Sizing factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
<b>Total</b>								<b>IMP Area</b>
								<b>V or V1</b>
								<b>V2</b>
								<b>Orifice Size:</b>





## Summary

- The

